On a Type-reading Optophone.

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(Communicated by Sir Oliver Lodge, F.R.S. Received May 2,—Read May 28, 1914.)

The production of sounds directly or indirectly due to the incidence of light is the general function of instruments of the type of Graham Bell's "photophone." An instrument designed to solve the more special problem of substituting the sense of hearing for the sense of sight is more appropriately termed an "optophone."

Having concerned myself for a number of years with this special problem, I described in 1912 an instrument which enabled sightless persons to locate bright lights or brightly luminous objects by means of the ear, and to discover shadows intercepting the light.* This result was obtained by putting two selenium preparations into two arms of a Wheatstone bridge, sending the galvanometer current through a telephone, and interrupting the current by a clockwork interrupter. A disadvantage of the method was that the action of the light was not instantaneous.

This disadvantage was eliminated in the "reading optophone" described in 1913.† The audible telephone current was produced by intermittent light of various musical frequencies, and by using 8 such frequencies, emitted by dots placed in a row, it was found possible to read transparent letters about 5 cm. high by learning to recognise the characteristic sound of each letter. In order to adapt this experimental instrument to the reading of ordinary letterpress by means of the ear, three further modifications were necessary:

(1) The length of the line of luminous dots had to be reduced from 5 cm. to about 1·5 mm., the size of ordinary type;

(2) The light had to be used after diffused reflection by the printed surface;

(3) The sensitiveness of the telephone arrangement had (as a consequence) to be greatly augmented.

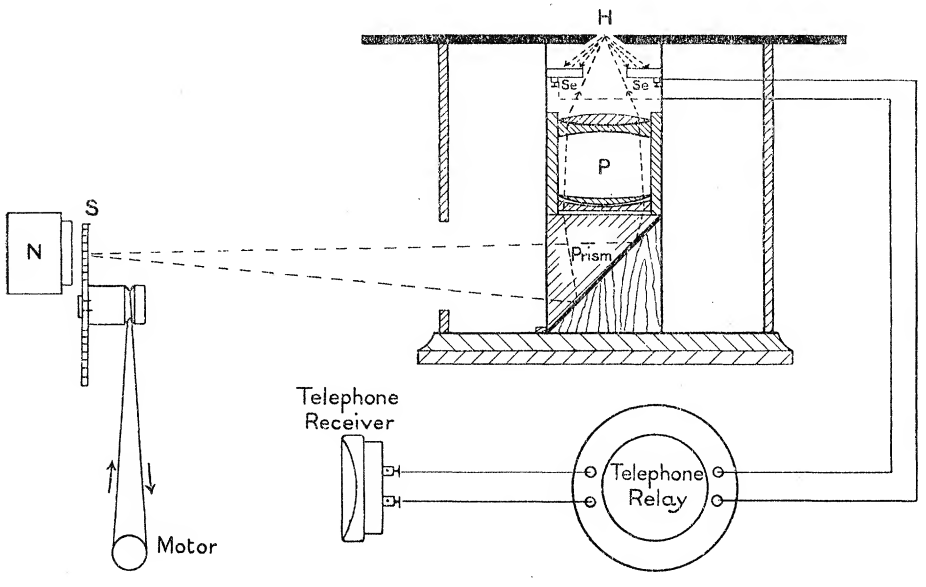
These modifications have now been made, and an instrument has resulted which should, with some practice, enable totally blind persons to read ordinary books and newspapers through the sense of hearing.

* 'Physikalische Zeitschrift,' vol. 13, pp. 942–943, Oct. 1, 1912. The instrument was shown at the Optical Convention of the United Kingdom, at South Kensington, on June 25, 1912.

† 'The Electrician,' vol. 72, pp. 102–193, Oct. 24, 1913. The instrument was shown in action at Birmingham University, on the occasion of the meeting of the British Association.

It consists of a small siren disc S, illuminated by a straight Nernst filament N; an optical arrangement for projecting an image of the line of luminous dots furnished by the revolving disc upon the type to be read; a set of selenium or antimonite bridges exposed to the light reflected by the type; a Brown telephone relay connected with these bridges; and the telephone receiver used for reading.

The optical arrangement consists of a right-angled prism which directs the horizontal beam of light coming from the siren disc upwards through the short-focus portrait lens P on to the small aperture H in the flat slab upon



which the sheet of letterpress is laid face downwards. The focal plane of the line of dots coincides with the upper surface of the slab and with the printed sheet.

The selenium bridge is placed as closely as possible to the print, and is perforated to allow of the passage of the incident light.

The siren disc is driven by an electric motor or a train of wheels actuated by a weight. Constancy of speed is desirable, but not absolutely essential.

When this is done, and a printed sheet is passed over the slab, the maximum sound is heard in the telephone when the paper exposed is white, and the minimum when it is black. The actual sound heard depends upon the shape of the letter. The small line of dots, 1·5 mm. long, is made to illuminate each letter in turn, the print being moved steadily in the direction of the printed line, which is at right angles to the luminous line of dots. The print is so adjusted that the line of dots just covers the

maximum height of the type used. The dots should be at least eight in number, six for the body of the letter, covering the whole height of such letters as *a* and *e*, and one dot each for the upper portion of such letters as *f* and *k*, and for the lower portion of such letters as *p* and *g*.

The note of each dot must be chosen so that it is easy to recognise its *omission* (not its *presence*, as in the case of the reading optophone previously described). Good results have been obtained with a set of notes with which both concords and discords can be obtained, according to the letters exposed. Such a series of notes is the following: g c′ d′ e′ g′ b′ c″ e″. But different arrangements may suit different ears.

A simple focussing device enables the operator to alter the length of the line of dots, and so adapt it to various sizes of type.

It is essential, in reading a line of type, that the alignment be perfect. This is ensured by a sliding device on the reading slab.

I wish to thank my lecture assistant, Mr. A. E. Vick, for his effective help in constructing the first working model of the instrument; and especially Sir Oliver Lodge for the kind interest he has taken in the whole investigation.

Studies of the Processes Operative in Solutions. XXIX.—*The Disturbance of the Equilibrium in Solutions by "Strong" and "Weak" Interfering Agents.*

By H. E. Armstrong, F.R.S., and E. E. Walker, B.Sc.

(Received May 7,—Read May 28, 1914.)

In a recent communication of this series (XXVI),* it was contended, that the change in the optical rotatory power of an aqueous solution of fructose which is produced by dissolving in the liquid a second substance, whether this be a salt or a non-electrolyte, is the consequence of an alteration in the proportion in which the two isodynamic forms of the compound are present in equilibrium. It was shown that substances such as the monhydric alcohols cause the change to take place in a direction opposite to that in which it takes place when substances such as sugar and salts are added: a similar antithesis has been observed in the course of these studies in numerous

* E. E. Walker, "The Disturbance of the Equilibrium in Solutions of Fructose by Salts and by Non-electrolytes," 'Roy. Soc. Proc.,' A, vol. 88, p. 246 (1913).